REMARKS

Present Status of the Application

The Office Action rejected all presently-pending claims 1, 3-10 and 12-17. Applicants have amended claims 1, 4, 10, 13 to improve clarity. It is believed that no new matter adds by way of these amendments to claims. For at least the following reasons, Applicants respectfully submit that claims 1, 3-10 and 12-17 are in proper condition for allowance. Reconsideration is respectfully requested.

Discussion of Office Action Rejections

The Office Action rejected claims 1, 2 and 5-9 under 35 U.S.C. 102(b), as being anticipated by Ho et al. (U.S. 6,184,138). The Office Action rejected claims 10-14 and 17 under 35 U.S.C. 102(e), as being anticipated by Mandal (U.S. 6,541,367). Applicants respectfully traverse the rejections for at least the reasons set forth below.

Applicants have amended claims 1 and 10 to more clearly define the present invention. The amended claims 1 and 10 read as follows:

1. A gap-filling process, comprising the steps of:
providing a substrate having a dielectric layer thereon, wherein the dielectric layer has an opening therein;
forming a gap-filling material layer over the dielectric layer and inside the opening;
removing a portion of the gap-filling material from the gap-filling material layer to expose the dielectric layer; and
conducting a gap-filling material treatment for forming ***a protective layer on an exposed surface of the gap-filling material layer, wherein the protective layer is not***

formed over the entire substrate but formed on the exposed surface of the gap-filling material layer.

10. A gap-filling process for fabricating a dual damascene structure, comprising the steps of:

providing a substrate;

sequentially forming a protective layer, a first dielectric layer, an etching stop layer, a second dielectric layer and a cap layer over the substrate;

forming a via opening passing through the first dielectric layer, the etching stop layer, the second dielectric layer and the cap layer;

forming a gap-filling material layer over the cap layer and inside the via opening;

removing a portion of the gap-filling material from the gap-filling material layer to expose the cap layer; and

conducting a gap-filling material treatment for forming ***a protective layer on an exposed surface of the gap-filling material layer, wherein the protective layer is not formed over the entire substrate but formed on the exposed surface of the gap-filling material layer.***

Ho discloses a method of forming a dual damascene structure comprises forming a barrier layer and a Cu seed layer over the substrate and on the surfaces of the dual damascene opening. Then, filling a material layer such as a spin-on material, SOG or polyimide into the opening. An etching step or a CMP is performed to remove a portion of the material layer. Thereafter, a protective layer is formed over the cap layer. The protective layer is typically deposited over the entire surface of the substrate (col. 8, lines 7-12, and Fig. 7). However, the protective layer of the present invention is formed on the exposed surface of the gap-filling material layer but not formed over the entire surface of the substrate. Therefore, Ho does not disclose all of the features of claim 1.

For at least the reasons discussed above, Ho cannot anticipate the amended claim 1. Claim 2 has been canceled. Claims 5-9 depend from claim 1 and, for at least the same reasons, are not anticipated by Ho.

Mandal discloses a method of forming a dual damascene structure comprises forming a dual damascene opening in a ILD layer and filling a Cu layer into the dual damascene opening. The Cu layer is palanarized, and then a capping layer (used as a protective layer) is deposited over the substrate by plasma assisted chemical vapor deposition of silicon oxide, silicon nitride, silicon oxynitride or hrdrogenerated silicon carbide (col. 10, lines 9-12). The protective layer 518 is formed over the entire substrate (Fig 8H). In Mandal's reference, the capping layer 518 also serves as substrate etch stop (col. 16, 25-26), hence the capping layer 518 should be covering the entire substrate. Therefore, Mandal did not disclose all of the features of claim 10.

For at least the same reasons, claim 10 is not anticipated by Mandal. Claim 11 has been canceled. Claims 12-14 and 17 depend from claim 10 and, for at least the same reasons, are not anticipated by Ho.

The Office Action also rejected claims 3-4 under 35 U.S.C. 103(a) as being unpatentable over Ho in view of Mandal. The Office Action also rejected claims 15-16 under 35 U.S.C. 103(a) as being unpatentable over Mandal in view of Ho.

Although Mandal discloses utilizing plasma assisted chemical vapor deposition to form the protective layer, the method of forming the protective layer of the present invention is performing a plasma treatment, UV curing or chemical immersion. The plasma treatment is different from the plasma assisted chemical vapor deposition disclosed by Mandal. Further, neither Ho nor Mandal nor their combination teaches or suggests all of the limitations of claim 1 or claim 10.

Hence, claims 1 and 10 as well as their dependent claims 3-4 and 15-16 are patentable over Hoi and Mandal.

For at least the foregoing reasons, Applicant respectfully submits that independent claims 1 and 10 patently define over the prior art references and should be allowed. For at least the same reasons, dependent claims 3-9 and 12-17 patently define over the prior art as well.

CONCLUSION

In view of the foregoing amendments and remarks, it is believed that the pending claims 1, 3-10, and 12-17 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,
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